business could not be included as one of the elements in determining the amount of damage to his land. (Ibid.)

A municipality is liable for damages caused by improper construction of a sewage-disposal plant.—A city is liable for injury caused by the construction and proper operation of a sewage-disposal plant, including necessary flushing of the septic tank; but the city is not liable for injury caused by the wrongful act of its servants in unnecessarily flushing a septic tank. (Ibid.)

A municipality can control the use of its sewers.—A city has the power to control and regulate its drains and sewers, and a property owner has no right to connect a private sewer with the city sewer without the consent of the municipality. (Kraver *v.* Smith [Ky.], P. H. R., Nov. 5, 1915, p. 3303.)

A municipality is liable for the acts of individuals which it permits.—A city has authority to regulate the character of the sewage which any property owner may discharge into the city sewer, but where a property owner is allowed to make connection with a city sewer and no attempt is made to regulate the character of matter discharged into the sewers, the city is liable for damages caused by the discharge of matter from the city sewers into a stream, creating a nuisance. (Ibid.)

Garbage—Disposal of.

Garbage-reduction plant not a nuisance.—A garbage-reduction plant erected under a contract made by a municipality, the contract being authorized by a statute and the plant operated under municipal supervision and in a proper manner, is not a public nuisance, and the company erecting such a plant can not be prosecuted criminally. (Toledo Disposal Co. *v.* State [Ohio], P. H. R., Nov. 26, 1915, p. 3507.)

Owners of apartment houses required to furnish garbage cans.—A Wisconsin law which required owners of apartment houses, tenement houses, and lodging or boarding houses to provide suitable receptacles for garbage was held to be valid. (Koeffler *v.* State, P. H. R., Sept. 18, 1914, p. 2455.)

ARTIFICIAL PURIFICATION OF OYSTERS.

A REPORT OF EXPERIMENTS UPON THE PURIFICATION OF POLLUTED OYSTERS BY PLACING THEM IN WATER TO WHICH CALCIUM HYPOCHLORITE HAS BEEN ADDED.

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It is generally known that the biological conditions most favorable for the cultivation of oysters are frequently intimately associated with natural agencies of pollution. Depending largely for their food upon substances washed down by rivers, shellfish grow best in bays and estuaries, and in many cases these waters receive the sewage of cities. While it may often be possible to remove the main sources of pollu-

tion, there will still remain many valuable areas where such expense would be unwarranted, or where it would not, for a long time, if ever, be possible to make the beds perfectly safe for the direct removal of oysters for the market. Under these conditions it is believed that the following studies may offer a solution of the problem of the purification of polluted oysters.

Certain facts, discovered in 1914 and 1915 during the progress of experimental studies at the Fisherman's Island laboratory, under the charge of Surg. Hugh S. Cumming, indicated the commercial possibility of artificially purifying polluted oysters. The natural cleansing of oysters when transferred to clean surroundings had been previously demonstrated by several investigators, and confirmed by experience. They variously stated the time requirement to insure thorough purification, agreeing generally upon a week or more. Prof. E. B. Phelps, in experiments at Narragansett Bay, found, however, that even after two days' sojourn in pure water, oysters had become satisfactorily cleansed. He did not study shorter times.

Experiments performed at this station showed that oysters heavily inoculated with *B. coli* freed themselves very rapidly when suspended in baskets placed directly in the tidal current at the mouth of Chesapeake Bay. Within a few hours during the summer months the greater part of the pollution had disappeared, though the last traces required longer periods for removal. Even during the so-called "hibernating" period, a few days in clean water ordinarily sufficed to wash out most of the sewage organisms. It was therefore certain that the purification of oysters could be accomplished in a period so short as to make the suggestion of artificial purification of oysters economically reasonable.

Experimental studies of the oyster physiology, feeding habits, and digestive mechanism explained the rapid disappearance of polluted matter. At feeding temperatures large volumes of water, from 25 to 50 gallons a day, pass through the oyster's gills. The rate at which food materials progress through its gastro-intestinal system is also surprisingly rapid. Feeding experiments showed that in less than half an hour particles touching the gill had moved to the mouth, and that within five hours they were being ejected with the feces. Unlike most animals, an oyster feeds as it breathes, and under favorable conditions a continuous stream of food material flows through the intestinal tract and is deposited in a solid ribbon beneath the oyster. As the total length of the whole passage is about 6 inches, it is not remarkable that so short a time is required in transit.

All indications, therefore, pointed to the active elimination of accumulated pollution and strengthened the conviction that the time required would not be the prohibitive factor in the artificial purification of oysters.

Basins of filtered sea water have been utilized in France for this purpose, but with the present market price of oysters in this country the expense of filtration would make such a method impracticable. However, the successful treatment of public drinking-water supplies with minute traces of calcium hypochlorite suggested a cheap and efficient means of accomplishing the same purpose.

In many places oysters are now kept for varying periods before marketing in basins or floats which, with little alteration in arrangement and at small cost for hypochlorite of lime, could be turned into suitable purification chambers. It is believed, moreover, that aside from the question of economy, water which had not been filtered would be even more effective, since the food particles would assist and hasten the discharge of polluted substances from the gut. Experiments were therefore undertaken to test out the practicability of artificially purifying oysters in water containing calcium hypochlorite.

Technique.

While the experiments were not made upon a commercial scale, all the conditions could be duplicated in practice, and they were in no sense "laboratory" experiments. One of the tanks at the station, having an inside length of 6 feet and a breadth and depth of 4 feet, was available for the purpose. It was filled with water directly from Chesapeake Bay, and in it from 30 to 40 oysters were suspended about 18 inches below the surface, in rectangular galvanized iron wire baskets, about 3 feet long and 18 inches wide and deep. Either liquid cultures of *B. coli* ("free coli") or *B. coli* in finely divided agar suspensions ("attached coli") were used to inoculate the tank. After the oysters had become thoroughly infected samples were collected for examination, and the water was disinfected with from 25 to 150 cubic centimeters of a 10 per cent suspension of commercial calcium hypochlorite. In most cases after about six hours a second dose was added to kill such bacteria as might subsequently have been discharged by the oyster, thus escaping the first treatment. This overcame any possibility that the oysters might have remained closed until the full strength of the hypochlorite had become appreciably diminished.

The mean of three separate tests, made for another purpose, was taken as indicating the initial condition of the oysters. In the first, the *B. coli* content per cubic centimeter of shell liquor of each of the five oysters taken for examination was averaged. In the second, the number of *B. coli* per cubic centimeter of a composite sample of equal volumes of liquor was determined; and, in the third, an analysis was made of the mucus obtained by vigorously shaking the five oyster bodies together. In the quantitative estimation of the number of *B. coli*, suitable dilutions of the material were inoculated into lactose bouillon according to the regular method. Fermentation of the

lactose, with subsequent typical appearance when smeared and grown upon endo medium, was considered a positive test for the organism. In this way a satisfactory index of the number of sewage organisms was obtained, and by using the mean of three independent tests on each sample of five oysters, a better value was obtained than would follow the use of any one of the tests singly.

Results.

The mean results of these tests, together with temperatures, times after dosing, and quantities of available chlorine added to the water in parts per million, are presented in the appended table. They show clearly a remarkable purification within 24 hours and a considerable change when tested after six hours. Whereas most of the initial samples were much more grossly contaminated than oysters usually are when taken from condemned beds, all but one had, after treatment, less than 10 *B. coli* per cubic centimeter, which is the standard set for the conditional approval of oysters by the Rhode Island Shell Fish Commission. The one exceptional case received but a single dose of disinfectant. It should be noted, furthermore, that the index here calculated is more severe than that based merely upon the examination of the shell liquor. With proper adjustment of conditions there is no reason to doubt that the best of these results could be equaled, and probably improved upon, in practice. Longer exposure to the treatment would yield even better results, if such were desirable.

The addition of disinfectant did not seem to interfere with the normal activity of the oysters themselves. Immediately after dosing the tank they appeared to close for a short time. Whether this was due to the effect of the chemical, or was merely the result of the disturbance, can not be definitely stated. Since the decomposition of hypochlorite is quite rapid, however, it was thought advisable to add the second dose, in order to make sure of the destruction of such organisms as might survive within the oyster and be subsequently discharged.

The method is quite analogous to natural purification in pure sea water. It has, however, two advantages, in that the process may be controlled and assured, and that the water need not contain more salt than does that upon the beds from which the oysters were taken, requirements hard to satisfy under natural conditions.

No change in the condition of the oysters could be detected, nor was it possible to distinguish any difference in flavor between the treated and the untreated oysters. Considering the small quantities of hypochlorite used and the general adoption of the hypochlorite method of treating public drinking waters, no undesirable effect would be expected. Sea water normally contains comparatively large amounts of the same chemical salts that result from calcium hypochlorite disintegration.

Conclusion.

The experiments are believed to prove that oysters which have lain in polluted water can be artificially purified to such a degree as to pass a most rigid standard by exposure for a short period in water containing calcium hypochlorite, and they appear also to demonstrate the feasibility of such a process.

Artificial purification of polluted oysters in water treated with calcium hypochlorite.

[Giving mean number of *B. coli* per c. c. in composite and individual shell liquor and composite mucus samples from 5 oysters.]

Inoculation.	Date.	Temperature, degrees.	Initial mean number B. coli per c. c.	Available chlorine added, parts per million.	Hours treated.	Mean number B. coli per c. c.	Available chlorine added, parts per million.	Hours treated.	Mean number B. coli per c. c.
Free coli	Aug. 25	27.0 C.	233.0	0.25	9	92.9			
Do	Aug. 31	24.5 C.	15.8	.25	8	.4			
Do	Sept. 2	21.0 C.	10.8	.60				29	1.6
Do	Sept. 7	25.5 C.	5.4	.63	6	.3	0.25		.1
Do	Sept. 16	27.0 C.	447.0	.38	6		.37		.2
Attached coli	Aug. 28	24.0 C.	680.0	.38				18	6.8
Do	Aug. 31	24.5 C.	3,690.0	.50	5½	169.0			
Do	Sept. 2	21.0 C.	251.0	.63	4	158.0	.62	24	1.6
Do	Sept. 10	26.5 C.	1,000.0	.25				24	13.1
Do	Sept. 14	27.5 C.	2,330.0	.25	6		.25	20	4.0
Do	Sept. 16	27.0 C.	2,000.0	.33	6		.33	12	1.3

PLAGUE-PREVENTION WORK.

CALIFORNIA.

The following report of plague-prevention work in California for the week ended June 17, 1916, was received from Senior Surg. Pierce, of the United States Public Health Service, in charge of the work:

San Francisco, Cal.

RAT PROOFING.

New buildings:	
Inspections of work under construction	205
Basements concreted (square feet, 86,025)	45
Floors concreted (square feet, 130,925)	29
Yards, passageways, etc. (square feet, 21,783)	98
Total area of concrete laid (square feet)	238,733
Class A, B, and C (fireproof) buildings:	
Inspections made	152
Roof and basement ventilators, etc., screened	710
Wire screening used (square feet)	3,950
Openings around pipes, etc., closed with cement	1,370
Sidewalk lens lights replaced	900
Old buildings:	
Inspections made	417
Wooden floors removed	62
Yards and passageways, planking removed	19
New foundation walls installed (cubic feet)	8,800
Concrete floors installed (square feet, 15,127)	25
Basements concreted (square feet, 44,665)	39
Yards, passageways, etc., concreted (square feet, 18,671)	70
Total area concrete laid (square feet)	78,463

San Francisco, Cal.—Continued.

RAT PROOFING—continued.

Old buildings—Continued.	
Floors rat proofed with wire cloth (square feet, 4,910)	7
Buildings razed	29
New garbage cans stamped approved	468
Nuisances abated	349

OPERATIONS ON THE WATER FRONT.

Vessels inspected for rat guards	23
Reinspections made on vessels	14
New rat guards procured	23
Defective rat guards repaired	11
Rats trapped on wharves and water front	38
Rats trapped on vessels	67
Traps set on wharves and water front	127
Traps set on vessels	241
Vessels trapped on	22
Poisons placed on water front (pieces)	3,600
Poisons placed within Panama-Pacific International Exposition grounds (pieces)	23,200
Bait used on water front and vessels, bacon (pieces)	6
Amount of bread used in poisoning water front (loaves)	9
Pounds of poison used on water front	3